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# Quaternary Fault and Fold Database of the United States

**As of January 12, 2017, the USGS maintains a limited number of metadata fields that characterize the Quaternary faults and folds of the United States. For the most up-to-date information, please refer to the interactive fault map.**

## Hilina fault system, Pulama pali section (Class A) No. 2610o

**Last Review Date: 2006-09-16**

***citation for this record:*** **Cannon, E.C., and Burgmann, R., compilers, 2006, Fault number 2610o, Hilina fault system, Pulama pali section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 12/14/2020 02:53 PM.**

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| **Synopsis** | **General:** The first person to map the faults on the south flank of Kilauea Volcano remains unknown, but Wood (1914 #6979) noted that subsidence occurred on the oceanward side of these structures related to the 1868 Great Ka'u earthquake, an estimated M8 earthquake (Wyss, 1988 #6980). Tilling and others (fig. 16, 1976 #6974) summarize faulting on the Hilina fault system associated with the November 29, 1975, M7.2 Kalapana earthquake. Lipman and others (1985 #6952) provide a comprehensive report of the 1975 Kalapana earthquake. Refer to the description of the November 29, 1975, Kalapana earthquake in this compilation for more details. Kellogg and Chadwick (1987 #6948) record 1975 Kalapana earthquake fault offsets preserved in the Mauna Ulu pahoehoe lava flows (1969-1974) for the central Hilina fault system. Riley and others (1999 #6972) estimate the depth of the Hilina fault system and recurrence interval for the |

1975 Kalapana earthquake using paleomagnetic measurements of south flank lava flows. Expanding on the work of Kellogg and Chadwick (1987 #6948), Cannon and Burgmann (2001 #6934) and Cannon and others (2001 #6935) present detailed fracture maps of central Hilina faults, estimate prehistoric fault offset rates and recurrence intervals for large (M>6) prehistoric south flank earthquakes, and provide evidence for a shallow rather than a deep-seated interpretation for some of the Hilina faults. Faulting along the Hilina fault system is related to large (M>6) earthquakes on the southern flank of Kilauea Volcano. Delaney and others (1998 #6939) conclude that the small strains observed across the southern flank in the past several decades suggest that the Hilina faults remained inactive except for during the 1975 Kalapana earthquake. The landslide and tsunami potential of the Hilina fault system remains a great concern. Ma and others (1999 #6984) estimate that the tsunami created by the 1975 Kalapana earthquake displaced approximately 2.5 cubic kilometers of water. Along the coast and offshore of Kilauea's south flank to the southeast, the Hilina fault system may represent the landslide headscarps to the submarine Hilina slump and Papa'u sand-rubble flow. Slumps and seafloor structures offshore of the Hilina fault system are interpreted as landslide blocks and debris (see Moore and others, 1989 #6961, 1995 #6958; Moore and Chadwick, 1995 #6959; Morgan and others, 2000 #6964, 2003 #6965). Significant coastal and submarine mass movements may have occurred within the past 100 ka. Geologic evidence demonstrates the existence of Quaternary deformation, but the fault system is associated with volcanic features that might not extend deeply enough to be a potential source of significant earthquakes.

**Sections:** This fault has 15 sections. The Hilina fault system is an approximately 50-km-long, 5-km-wide zone of primarily normal faults that extend east across the southeastern flank of Kilauea Volcano. For this long fault system, we identify 15 fault sections based on fault-scarp morphology reflected on 7.5-minute topographic maps, continuity of expression, and evidence of apparent recent movement from cross-cutting relations of faults, fractures, and lava flows. The large number of sections for this fault system in particular is largely the result of young movement, high rates of movement, associations with large historic earthquakes, and focused study by researchers. The 15 sections are Pu'u Mo'o [2610a], Kukalau'ula Pali [2610b], Hilina Pali [2610c], Keana Bihopa [2610d], Pu'u Ka'one [2610e], Pu'u Kapukapu [2610f], Makahanu Pali [2610g], Pu'u'eo Pali [2610h],

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| | Kipukapapalinamoku 2610i], Poliokeawe Pali [2610j], 'Ainahou [2610k], Holei Pali [2610l], 'Apua Pali [2610m], Paliuli [2610n], and Pulama pali [2610o]. |
| **Name comments** | **General:** The Hilina fault system consists of a set of roughly east-trending normal fault structures with moderate dips to the south and southeast. The term pali, used in several of the section names, is the Hawaiian work for "cliff" or "scarp." For example, the name Hilina Pali represents the geomorphic scarp of the Hilina fault. Another term used, pu'u is the Hawaiian work for "hill."<br><br>**Section:** Informally name for the easternmost fault section of the Hilina fault system. |
| **County(s) and State(s)** | HAWAII COUNTY, HAWAII |
| **Physiographic province(s)** | HAWAIIAN-EMPEROR ISLAND-SEAMOUNT CHAIN |
| **Reliability of location** | Good<br>Compiled at 1:100,000 scale.<br><br>*Comments:* The fault trace is shown as concealed on the 1:100,000-scale geologic map (Wolfe and Morris, 1996 #6977), and the geomorphic fault scarp is recognizable on the 1:24,000-scale Kalapana topographic map. |
| **Geologic setting** | The Hilina fault system is a normal fault system in the southern flank of Kilauea Volcano, Hawai'i. The present southern flank is being displaced to the southeast along a basal detachment by high-level rift zone intrusions and deep-seated gravitational spreading of the island. Between 1990 and 1996, south flank horizontal velocity rates determined from global positioning system (GPS) surveys indicate as much as 10 cm/yr of lateral motion (Owen and others, 1995 #6968, 2000 #6969). This slightly northwest-dipping basal detachment at approximately 8-10 km depth represents the boundary between ocean lithosphere and the volcanic edifice. Pelagic sediment deposited on the seafloor prior to the formation of the volcanic edifice could be lubricating the basal detachment and promoting southeastward motion of the south flank. A comprehensive analysis of geodetic data for the 1975 Kalapana earthquake (Owen and Burgmann, 2006 #6985) indicates that measured ground deformation on the south flank is best explained by a combination of faulting of the basal |

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| | detachment, opening of the east rift zone [2608b] and southwest rift zone [2608c], a summit eruption and collapse of the summit magma chamber, and faulting on the Hilina fault system.<br><br>Sections of the Hilina fault system may vary in depth from shallow, arcuate normal faults to steeply dipping normal fault splays off the deep, basal detachment. Cannon and others (2001 #6935) conclude that Holei Pali [2610l] and 'Apua Pali [2610m] have fault dips of about 20? at the surface and may flatten downward, reaching a 1-2 km depth at the coast and possibly intersecting the base of a 2- to 3-km-thick hyaloclastic layer offshore (Morgan and others, 2000 #6964). Riley and others (1999 #6972) interpret Hilina Pali [2610c] to be a cylindrical (curved) fault that extends to a depth of 5 km. The Hilina fault system may also be a network of steeply-dipping normal fault splays off the 8- to 10-km-deep basal detachment (Lipman and others, 1985 #6952), with microseismicity possibly being localized at the intersection (Okubo and others, 1997 #6982). |
| **Length (km)** | This section is 14 km of a total fault length of 50 km. |
| **Average strike** | N. 70° E. (for section) versus N. 69° E. (for whole fault) |
| **Sense of movement** | Normal<br><br>*Comments:* From Wolfe and Morris (1996 #6977). |
| **Dip Direction** | N; S; SE<br><br>*Comments:* From Wolfe and Morris (1996 #6977). |
| **Paleoseismology studies** | |
| **Geomorphic expression** | The largest scarp is 90-150 m high. |
| **Age of faulted surficial deposits** | Surface lava flows that have ages of 200-400 yr B.P., 400-750 yr B.P., and 1,500-3,000 yr B.P. cover inferred faults over most of Pulama pali (Wolfe and Morris, 1996 #6977). The eastern region contains a set of normal faults that cut 1,500-3,000 yr B.P. lava flows. In addition, some normal faults are buried by 1985-1992 Pu'u 'O'o lava flows (D.A. Swanson, written commun., 2005). Faulting in the eastern region may be part of Pulama pali [2610o] or Paliuli [2610n]. See Holcomb (1987 #6944) for details of ages of individual lava flows. |

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| **Historic earthquake** | Kalapana earthquake 1989<br>Kalapana earthquake M7.2 1975<br>Ka'u earthquake 1868<br>Kaimu earthquake 1823 |
| **Most recent prehistoric deformation** | latest Quaternary (<15 ka)<br><br>*Comments:* timing of most recent surface rupture not reported but assumed to be late Holocene based on lava flows that are cut by the fault. Tilling and others (1976 #6974) do not report faulting that resulted from the 1975 Kalapana earthquake. Faulting may have occurred during the June 25, 1989, ML6.1 Kalapana earthquake. Wyss and Koyanagi (1992 #6981) report ground breakage along the road between Kalapana and Kapa'ahu in the vicinity of the eastern termination of the fault section. |
| **Recurrence interval** | |
| **Slip-rate category** | Greater than 5.0 mm/yr<br><br>*Comments:* Slip rate not reported. The assigned slip-rate category of >5 mm/yr is based on faults that cut late Holocene lava flows and on a large scarp height similar in size to Holei Pali [2609l]. |
| **Date and Compiler(s)** | 2006<br>Eric C. Cannon, none<br>Roland Burgmann, University of California at Berkeley |
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